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TECHNICAL NEWS BULLETIN NOW ISSUED IN PRINTED FORM

During the fall of 1917 the Bureau of Standards decided to send out a mimeographed confidential bulletin at frequent intervals describing progress of work in the laboratories. Its principal object was to keep the military branches of the Government informed of what was going on at the bureau, thus avoiding duplication of effort and loss of time.

Twenty-six numbers of this Confidential Bulletin were issued between December, 1917, and June, 1919. The title of the bulletin was then changed to the Technical News Bulletin, and the mailing list was considerably enlarged. The Technical News Bulletin has been issued in mimeograph form each month since the above date, and in that time the mailing list has increased to three times its original size. Its character has also changed, and it is now very largely an industrial list.

In order to care for the greatly increased demand for the bulletin it has been decided to print it, this being the first number to appear in that form. The character of the material which it will contain and the date of issue will be the same as heretofore.

ONE HUNDRED AND THIRTY-THIRD REGULAR MEETING OF THE AMERICAN PHYSICAL SOCIETY

The one hundred and thirty-third regular meeting of the American Physical Society took place at the Bureau of Standards on April 24 and 25. In all, about 70 papers were presented, many of them dealing with problems in atomic physics.

F. L. Brown and J. W. Beams, jr., of the University of Virginia, told of their work in connection with the electric arc. They have devised apparatus by which it is possible to record the extremely rapid changes which take place when the arc is started, the intervals recorded being less than one-hundred-millionth of a second. This investigation has shown that it takes a measurable, though very short, time for an arc to get started, and that its appearance during its early stages is quite different from when it is fully under way. In this study the light from the arc was broken up into its components by means of the spectroscope, appearing as a number of spectral lines, each of which indicated the presence in the arc of light of a particular wave length, and formed by a particular kind of collision between a speeding electron and an atom of the air or of the metal forming the electrodes. Lines due to nitrogen atoms in the air appeared first, the atoms of the metal taking more time to get into a position in which the electrons could make them give off light.

Measurements of the viscosity of organic liquids at high pressures were reported by P. W. Bridgman, of Harvard. Bridgman found that all the liquids tested became more viscous at high pressures and that they moved more sluggishly. This he attributes to the interlocking of the molecules, which causes the liquid to take on properties more nearly approaching those of a solid. The increase varied enormously between different liquids, being only ten times in the case of methyl alcohol and one million times for eugenol. The pressure range was from atmospheric to eleven thousand times that pressure, or 170,000 lbs./in.^{2}

A new type of instrument for measuring the tension of airship fabric in place was described by Tuckerman, Keulegan, and Eaton, of the Bureau of Standards. This fabric tension meter is capable of measuring the tension when only one side

of the fabric is accessible, as is frequently the case in the gas bag of an airship or the fabric of an airplane wing. The instrument consists of an open chamber having an elliptical cross section and provided with pressure gauge and deflection meter. The edge is provided with suction holes so that a given area of the fabric can be isolated, and the pressure required to produce a given deflection permits the calculation of the tension in the fabric.

Investigations of the binaural method of locating sounds were reported by C. E. Lane, of the Bell Telephone Laboratories, while F. R. Watson, of the University of Illinois, told of methods being used for studying the acoustics of auditoriums.

C. M. Blackburn, of the University of Chicago, told of some studies of the light from comets' tails, which indicate the presence there of large amounts of carbon monoxide. Changes in the magnetic declination during the eclipse of January 24 were reported by Charles T. Knipp, of the University of Illinois, and measurements of the light intensity during the partial eclipse at Washington were reported by I. G. Priest, of the Bureau of Standards. W. W. Coblentz, also of the bureau, told of the measurements of the heat radiation from Mars which he made last summer, in cooperation with D. H. Menzel and C. O. Lampland, of the Lowell Observatory, Flagstaff, Ariz., and of the temperatures of different parts of the Martian surface computed from these measurements.

Many of the other papers presented at the meeting gave data of value in the study of atomic structure and of the arrangement of the atoms in solids. Numerous measurements of the spectra of the elements were reported, together with studies of X rays, photo-electric phenomena, etc.

AERONAUTICAL SAFETY CODE COMPLETED

Final action in revising the American Aeronautical Safety Code was taken by the sectional committee at a meeting held at the bureau on April 23. The chairman of the committee, H. M. Crane, past president of the Society of Automotive Engineers, conducted the meeting, which was attended by 20 members or alternates, as well as several members of subcommittees.

This project, which is sponsored by the Society of Automotive Engineers and the Bureau of Standards, has been carried out by a sectional committee, made up of representatives of all interests concerned with safety in aeronautics, acting under the auspices of the American Engineering Standards Committee. The several parts of the code have been printed by the Society of Automotive Engineers and widely distributed for criticism and suggestions.

At the meeting on April 23, each part of the code was gone over, and suggestions for changes which have been made since the printed drafts were issued were given consideration. A number of minor changes were made, and the revised draft of the code was then adopted as a final document by the sectional committee. The sectional committee is, however, a continuing body, and although the first edition has been completed by the action of this meeting, the committee will continue to function in making future revisions from time to time as they may appear to become necessary by progress in the art or as a result of experience in applying the requirements of the code to commercial aviation. Most of the changes made at the meeting of April 23 were of minor importance. Among them, the following may be mentioned:

No definitions will be listed in the introductory part of the code, as at first intended, but the glossary of the National Advisory Committee for Aeronautics will be referred to in this connection by title.

In rule 122, where coloring for the identification of pipe is recommended, the committee decided upon orange to indicate fuel pipes, yellow for lubricating oil, white for water, admiralty green for air, and red for fire-extinguishing materials.

In rule 130, where the ultimate strength of spruce had been specified, this was omitted, and a requirement inserted that stresses in wooden members be based on the timber tests of the United States Forests Products Laboratory, Madison, Wis.

In the part on power plants, rule 211 dealing with tests of engines contains a new paragraph specifying that the engine shall be disassembled after the overspeed test, and if any major parts are deemed unsafe for flying, the engine will be declared to have failed to pass the type test. The performance of the cooling system is specified in terms of the rise in temperature of the water, the rise being limited to 100° F. above that of the surrounding air.

In part 4 dealing with signaling equipment, the United States regulations for radio will be inserted, and in part 7 it is specified that pilots of aircraft carrying passengers should have had adequate experience with the particular type of craft used.

FACTORS WHICH DETERMINE THE MINIMUM STOPPING DISTANCE OF AN AUTOMOBILE

Owing to the fact that many persons have an indefinite idea as to the number of feet in which an automobile may be stopped, a paper based on a recent investigation of this subject has been prepared by H. H. Allen, of the bureau's staff, and will probably be published at an early date in the Journal of the Society of Automotive Engineers.

This paper explains the conditions which affect the stopping distance, as well as the relations of these several conditions. From the equations and curves included in the paper, the minimum stopping distance may be predicted with reasonable accuracy under given conditions, or these conditions determined if the stopping distance is known.

For instance, from a speed of 20 miles per hour, a small coupé, such as a Ford, equipped with two-wheel brakes, could not be stopped in less than 44 feet on a dry concrete road, having a coefficient of traction of about 0.7. On the same road, and at the same speed, a large seven-passenger touring car with two-wheel brakes could be stopped in 37 feet. With four-wheel brakes either car could be stopped in about 20 feet. If the coefficient of traction is 1.0, as it might be on rough concrete, the car with four-wheel brakes could be stopped in 14 feet.

It is shown that the stopping distance is influenced by the coefficient of traction between the wheels and the road, and this in turn depends on the percentage of weight carried on the braked wheels. This is 100 per cent in the case of four-wheel brakes, while for two-wheel brakes this percentage, and hence the stopping distance, is affected by the position of the car's center of gravity in relation to the wheel base. A short, high car tends to nose over when the brakes are applied, thus reducing the weight on the rear wheels.

The legal value of such information as that contained in the paper is pointed out.

BRAKE TESTS OF MOTOR TRUCKS

The Bureau of Standards, in cooperation with the Bureau of Public Roads, recently carried out brake tests on about 330 motor trucks in and about Cincinnati, Ohio. In general, it was found that the stopping distance is not dependent upon the weight of the truck, and that the average stopping distances for motor trucks are greater than for passenger cars. This appears to be due to the inadequacy of the brake equipment, but there is no evidence of any inherent difficulty in making brakes which will give as short stopping distances for trucks as for passenger cars.

INTENSITY AND DURATION OF FIRE IN A RECORD ROOM

The special building which the bureau employs to determine the intensity and duration of fires was burnt out recently, after having been fitted up to simulate a record-room occupancy. The material used consisted of records and books on

open wood shelves, 8 feet high. The total amount of combustible contents was 58 lbs./ft.^{2} of floor area, as compared with 10 or 12 pounds in the previous tests which represented office occupancies. The intensity of the fire was higher in this last test than in any of the others, a maximum temperature of 2,000° F. having been recorded for a short period. The duration was also greater than in previous fires. The reduction of the temperature data has not been completed, but indications are that the effective duration as compared with previous tests was somewhat greater than would obtain if it were proportional to total amounts of combustible contents. The bureau is at present working on plans for a larger structure in which similar tests can be carried out.

TESTING OF FIRE HOSE

The testing of fire hose for the Government departments is one of the important activities of the bureau. Aside from the physical and chemical tests which are made to ascertain if materials of the proper quality have been used in the construction of the hose, hydrostatic tests are made on the finished 50-foot lengths, and often bring to light some rather unusual characteristics.

The most common type of fire hose consists of a rubber lining over which are placed two woven cotton jackets. It is usually made in 50-foot lengths with a coupling at each end. For the hydrostatic test the hose is laid out on a level floor, one end being capped, and the other connected to a hydraulic pump. As the pressure in the hose is gradually increased from 0 to 400 lbs./in.^{2} (the test pressure) several things are seen to take place. There is usually a certain amount of "warping" which gives the hose a snake-like appearance. The hose also twists on its axis in one direction or the other, and increases in length so that often a hose which is 50 feet long under no pressure will be 52 or 54 feet long under 400 pounds pressure. Certain tolerances are allowed for all these items. If a hose tends to twist (which is almost always the case) it must be in a direction which will tighten rather than loosen the couplings. The Federal requirements for purchase of fire hose are described in Bureau of Standards Circular 114.

During the past year the bureau has tested for the various Government departments samples of fire hose representing purchases amounting to approximately $50,000.

VARIATION IN THE METHOD OF OBTAINING BREAKING STRENGTH OF ROPE

A survey of methods of testing the breaking strength of rope recently made by the Bureau of Standards has shown that a wide variation in practice exists. This information was desired not only to obtain some record of the different methods, but also to ascertain just what conditions existing apparatus could meet.

According to the United States Government Master Specifications for Manila Rope, Federal Specifications Board No. 61, the breaking strength tests include the following conditions:

(*a*) Speed (rate of speed of pulling head) not more than 4 inches per minute.
(*b*) Size of splice not less than 7 inches. Drum method is also permitted.
(*c*) Distance between splices (or drums), minimum, 5 feet.

The questionnaire, therefore, covered type of machine, capacity, speed used in testing, possible speeds of machine (maximum and minimum), and methods of holding.

The replies received, with two or three exceptions, showed that the conditions of this test could be met by adjustments of apparatus now in use in these testing laboratories.

A description of this survey, together with a short discussion covering the need for a standardized test method for rope has been written, and will be published shortly in a trade paper.

COLOR OF PAPER FILLERS

The bureau has recently completed color measurements of samples representative of average commercial materials used as paper fillers.

The measurements were made with the Pfund colorimeter, modified as found necessary for material of this nature. All samples were tested as dry powder, the sample holder being constructed of brass boxes with optical glass over the reflecting surfaces of the material, this arrangement being necessary to support the material in the upper holder and to give uniform test surfaces. In order to counteract any selective absorption of the glass covers, a piece of the same glass was placed between the ground-glass mirror and the light source. The upper glass cover had a round hole, somewhat less than one-half inch in diameter, in its center to permit unobstructed reflection of light from the material under test into the optical cube of the colorimeter. A complete description of the Pfund colorimeter as originally designed is given in Bureau of Standards Technologic Paper No. 244.

The results are given in the following table. A sample of chemically pure magnesium oxide is included for comparison. The values in the total column are the sum of the reflection values for red, green, and blue light, and indicate the total relative brightness of each sample; that is, the relative quantity of light reflected by each sample.

The quality of light reflected by each sample is indicated as "per cent reflection" for each color of light. The ideal material would reflect equal percentages of each color, which, in these cases, would be 33⅓ per cent. The departure, therefore, of each sample from this value indicates the extent of departure from whiteness as regards each color and therefore shows the hue of the sample.

Color measurements of paper fillers

Kind of material	Sample number	Reflection value for each color			Total relative brightness	Reflection for each color		
		Red	Green	Blue		Red	Green	Blue
						Per cent	*Per cent*	*Per cent*
Asbestine	1	0.924	0.901	0.862	2.687	34.4	33.5	32.1
Clay	2	.896	.842	.769	2.507	35.7	33.6	30.7
Gypsum	3	.966	.923	.883	2.772	34.9	33.3	31.8
Clay	4	.941	.890	.813	2.644	35.5	33.6	30.9
Crown filler	5	.986	.966	.934	2.886	34.2	33.5	32.3
Talc	6	.927	.908	.861	2.696	34.4	33.7	31.9
Clay	7	.801	.750	.706	2.257	35.5	33.2	31.3
Gypsum	8	.844	.818	.784	2.446	34.5	33.4	32.1
Clay	9	.934	.880	.804	2.618	35.7	33.6	30.7
Magnesium oxide	10	.946	.924	.900	2.770	34.2	33.3	32.5

TESTS OF THE PROPORTIONING OF CONCRETES FOR A GIVEN COMPRESSIVE STRENGTH AT 28 DAYS

Present-day practice in commercial concrete operations tends toward the specifying of concrete by strength for a given supply of materials, rather than the specifying of definite proportions which through long experience may be expected to furnish a concrete of the desired strength at 28 days. In order that the bureau might have laboratory data on the present methods of proportioning the ingredients to give a definite strength at the 28-day age, a limited series of tests was carried out.

Three sands (Q–No. 8, Q–No. 4, and Q–⅜) and three sizes of pebbles (No. 4 to ¾ inch, No. 4 to 2 inches, and ⅜ to 1½ inches) were included in the work. Each sand was combined with each size of pebbles, in eight different proportions. Three different slumps were used, ½ to 1 inch, 6 to 7 inches, and 8 to 10 inches. The 72 mixes are found on pages 10, 12, and 14 of Bulletin 9 of the Structural Materials Research Laboratory under the sizes of aggregate and slump here given.

For each mix, five companion 6 by 12 inch test cylinders as nearly alike as possible were made, each on a different day. In all 360 cylinders were made. The

specimens were cured under damp storage conditions and tested when 28 days old. The cement used in the tests was of a standard brand meeting the Government requirements, and the aggregates were washed Potomac River sand and pebbles.

The ratio of volume of water to volume of cement in a mix has been found to offer a fair index of the strength. The expression 14,000, divided by 7 raised to a power equal to the water-cement ratio, has been proposed by the Structural Materials Research Laboratory for determining the strength, and seems to be used to a considerable extent in practice for this purpose. This expression has been used as a criterion for studying the results of these tests.

It was found that mixes in which the quantity of aggregate which passed through a No. 4 sieve was less than one-third of the total aggregate, as well as the mixes in which the quantity of coarse aggregate of some one size was less than one-third as great as the quantity of aggregate twice as large, generally gave strengths less than that shown by the expression used as a criterion. If the mixes referred to be eliminated, all the remaining mixes gave strengths as great or greater than the criterion. In determining the quantity of coarse aggregate of different sizes, the aggregate was screened on a set of screens whose mesh opening advanced in size by multiples of two from the opening of a No. 4 sieve (0.094 inch) to an opening large enough to admit the largest aggregate. The amount of aggregate between any two consecutive screen sizes is referred to as of one size, and each size was considered to be twice as great as the next smaller size.

So far as these tests indicate, it may be concluded that the expression 14,000, divided by 7 raised to a power equal to the water-cement ratio, is a fair measure of the strength of concrete, provided that at least one-third of the aggregate is sand (that is, smaller than a No. 4 sieve) and that the quantity of coarse aggregate of any one size is not less than one-third as great as that of the next larger size.

Other tests not included in the investigation indicate also that the sand should not be more than half the total aggregate in order to meet this criterion.

CRUSHED LIMESTONE AND HOLLOW-TILE WASTE AS CONCRETE AGGREGATE

Often a considerable amount of waste accumulates at quarries producing dressed limestone, and similar conditions exist at plants manufacturing hollow building tile. In an investigation of possible uses for these waste materials the Bureau of Standards recently carried out a few tests on concretes in which they were employed as coarse aggregates.

Forty-five 6 by 12 inch test cylinders were made in which Potomac River sand was used as fine aggregate, and Potomac River gravel, tile waste, and limestone waste were used in one-third of the cylinders as coarse aggregate. Three proportions by volume, 1:2:4, 1:2½:5, and 1:3:6, were used for each coarse aggregate. The coarse aggregate was crushed, and only that proportion between the No. 4 and 1½-inch sieves was used. All mixes were brought to the same flow of 90 as measured by the flow table. To obtain these flows the amount of water by weight of the total dry materials was 9.7 per cent for the gravel aggregate, 13.8 per cent for the limestone aggregate, and 15.4 per cent for the tile aggregate.

The specimens were stored in the damp closet, and were tested at the age of 28 days. The strengths developed by the 1:2:4, 1:2½:5, and 1:3:6 mixes, respectively, for the gravel concrete were 1,680, 1,185, and 835 lbs./in.^{2} For the tile concrete the corresponding strengths were 2,070, 1,328, and 957 lbs./in.^{2}, and for the limestone concrete they were 1,525, 972, and 777 lbs./in.^{2}

The results of the tests indicate that in so far as strength is concerned these materials are suitable for coarse aggregates in concretes. However, both materials produced rather harsh working mixes as compared to the gravel mixes, and in

order to secure ease in handling and placing of these concretes it probably would be well to use over sanded mixes.

THE ABRASIVE HARDNESS OF CERAMIC GLAZES

This investigation was authorized by the bureau for the purpose of (a) developing a suitable apparatus to determine the extent of abrasion of a surface; (b) to discover the elements influencing resistance to abrasion; and (c) to manipulate these governing factors in a manner to produce low-fired glazes of good quality.

In order to determine abrasive resistance it is necessary (a) to abrade the specimen under controlled conditions, and (b) to measure the abrasive effect of a definite treatment.

For the first stage of the process an apparatus has been devised, as described in the Journal of the American Ceramic Society, vol. 7, No. 5, May, 1924. To make this apparatus more adaptable to new developments, the rate of flow has been reduced from 6.4 to 2.0 pounds per minute and the height of fall to 2 feet (one-half its original value). This was done after certain work was carried out showing the relation between rate and height of flow and abrasion.

The question of measurement of abrasion has been approached recently by both optical and photographic means. The suitability of the Ingersoll glarimeter for this work is under investigation, as well as a photographic method. The latter gives excellent results but is cumbersome.

As a subsidiary investigation, comparison was made of the resisting quality of the same glazes burnt on (a) vitreous tiles, (b) unground, and (c) ground semi-vitreous bisque. A specimen of each was prepared with 10 different glazes (a total of 30), and the average of each group compared. The data indicate that glaze on the ground bisque is slightly more resistant than on the unground bisque and tiles, but the range is sufficiently close to justify the use of any one of the materials for research purposes, provided no other factors need be considered.

An unexpected and interesting relationship was noted between members of a group of experimental glazes which vary from low SiO_2–Al_2O_3 to high SiO_2–Al_2O_3 and touch intermediary points at regular intervals. The general conception is that glazes containing greater quantities of SiO_2 and Al_2O_3 have a higher abrasive resistance than the high alkali glazes. The present system of testing indicates a reversal of this idea, and upon graphical representation of experimental data an ascending resistance value toward the low SiO_2–Al_2O_3 members was revealed.

THE ADHESION OF GYPSUM PLASTER TO BACKINGS

The Bureau of Standards has completed an investigation relating to the adhesion of gypsum plaster to all of the various backings commonly employed in practice. Although the art of plastering has been known for many centuries, a search through the literature discloses a complete lack of information on the subject of adhesion of wall plasters. Therefore, when a new material appears on the market to be used as a backing for plaster there is no information available as to the adhesion required of it. In order to supply this information, tests were made on the adhesion of gypsum plaster, a representative wall plaster, to all of the backings commonly used in practice. It is now possible to compare these data with the results obtained with any new material, and in this way the value of the new material as a backing can be ascertained in so far as adhesion is concerned. The gypsum plaster was applied to specimens of the various backings, and after the plaster had been allowed to age for seven days it was pulled free of the backing. The force required to rupture the bod was determined and recorded.

The kinds of backings employed may be divided into two general types (1) masonry, and (2) laths. Each of these types included many varieties. Backings tested were plastered with the recommended sanded-mixes of gypsum plaster of about three-fourths inch grounds. The plaster was retarded so as to set in about four hours.

The size of the specimens of the various backings was about 12 by 14 inches, and the area of the plaster was about 9 by 9 inches. Embedded in the plaster was a mechanical device through which a force could be applied to pull the plaster from the backings. At the completion of the aging period, the specimens were put in a testing machine and a continually increasing force was applied to the device until the bond between the plaster and backings ruptured.

The results obtained in these tests show that there is a great difference in the values for the adhesion of gypsum plaster to different kinds of backings, there being also a wide range of values within each type. The results show very strikingly that the tenacity of adhesion depends to a large extent upon the character of the surface to be plastered. In the case of brick and tile it was found that the roughest side of the brick wall or tile offered the better mechanical key and gave the greater adhesion. On the other hand, the porosity or total absorption of the brick or tile does not seem to govern the adhesion.

Assuming the weight of a ¾-inch plaster coat at 6 lbs./ft^2 it was found that the factor of safety of any of the backings tested was relatively high. A detailed report of the work is being prepared for publication.

MEASUREMENT OF THE HIDING POWER OF PAINTS

During the past few months work has been done on the photometer method of measuring the hiding power of paints, the measurement having been made upon dry paint films. While no equation mathematically derived from physical considerations has been deduced, a determination can readily be made by use of an empirical formula, with considerable facility and accuracy.

The bureau defines complete hiding as that thickness in millimeters of any paint film spread on a black and white plate which will cause the brightness over the black half to be not less than 98 per cent of the brightness over the white half. Theoretically complete hiding will never be obtained with a film of less than infinite thickness. The chosen value of 98 per cent was close to the average of a number of trials in the laboratory to determine the sensitivity of the eye for small variations of shade, and is a good practical figure for moderate illumination and natural visibility conditions. As the underlying surface, the bureau employs a glass plate, half black and half white, the white and black shades being as nearly perfect as possible.

The black and white disk is coated with paint by rotating the disk around an axis through its center at a suitable speed, and by pouring a small quantity of paint upon the disk as it rotates. Most of the paint is quickly thrown off by centrifugal force, leaving a film of very fine texture and surface upon the disk. In this manner a film of paint is obtained which varies in thickness from a minimum at the outer edge to a peak at the very center. Thus on a single whirled plate a dozen or more measurements can be made, each upon a different thickness of paint film.

The relative brightness, "a," of the two sections of the coated disk is measured with a Marten's photometer. The film thickness, "b," is measured with an Ames' dial. The hiding power of the paint, "x," that is the minimum thickness required for complete hiding as defined above, can be calculated at once from the empirical formula

$$x = 7b\sqrt{\frac{1}{a} - 1}$$

This empirical formula has held within the experimental error for all the numerous data the bureau has so far obtained. However, the problem is being further studied with the hope that the same or a similar equation based on sound physical conceptions of the reflection and absorption of light in its passage through a paint film can eventually be deduced.

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